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ABSTRACT

This study attempted the following: a) to establish the criteria that judges used in the Outstanding Biology Teacher Award Program to evaluate biology teachers, b) to identify their various occupations, c) to establish whether or not criteria were valued significantly differently, and d) to determine if occupational status of judges is significantly related to such ratings. Regarding evaluation of biology teachers, it is possible to say that touchstones do exist which are significant for competent judges. Also, concerns for evaluator bias are real worries, for various judges do value specific criteria differently, and professors of science education and college biologists differ somewhat in how they value specific criteria. (Results of the evaluation of data are included in the text.) (Author/JA)

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HOW EDUCATORS OF TEACHERS OF SCIENCE EVALUATE BIOLOGY TEACHERS

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By

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BACKGROUND

As part of a study to determine the relative value of various criteria which might be used when evaluating the worth of biology teachers, some data was elicited about those which professors of science education and college biologists felt to be most important.

Generally, efforts to find suitable methods for evaluating teacher competence and teacher effectiveness have been disappointing. Review of these studies reveals much concern by investigators over which criteria should be applied, about who should do the evaluating, and, about the effects of subjective bias on the part of the judges involved.

Because of concerns about the suitability of criteria and the subjective biases which might be introduced into the process by judges having different expectations, and knowing that in spite of these limitations biology teachers are regularly evaluated, the study attempted to reveal what various groups of judges engaged in an ongoing national program actually thought to be important and to determine ways the job category of judges related to the criteria they valued most.

Even though no comprehensive studies were found regarding the evaluation of biology teachers, the National Association of Biology Teachers (NABT) for about a decade has been actively engaged in a well-organized and formal program of biology teacher evaluation for its Outstanding Biology Teacher Award. In this program (OBTA), a teacher from each state is selected as an "Outstanding Biology Teacher" each year with procedures requiring that individual state selection committees be formed to evaluate candidates for the award. The composition of each state selection committee is varied, but usually consists

of persons representing secondary school teachers, administrators, science supervisors, college and industrial biologists, and professors of science education.

STUDY DESIGN

In an effort to gain some understandings of how these biology teachers are evaluated, the study asked each of the judges of the 1970 OBTA program to rate the various criteria they employed when evaluating candidates for the award. The study involved the two hundred twenty members of the forty-seven state selection committees active in the 1970 program of OBTA and the data provided by the one hundred seventy-nine who returned completed questionnaires. The composition of judge groups is shown on Table 1.

Assumptions made in the study were that:

1. Criteria exist which characterize outstanding biology teachers.
2. OBTA judges are appointed for their ability to recognize outstanding biology teaching and that these persons are competent to judge biology teachers.
3. Judges employ these criteria when making decisions about the suitability of candidates for the award.
4. A "value hierarchy" of criteria exists, with some criteria being of more importance than others in evaluating candidates for the award.
5. Assessment of candidates for the award is subjective and that individual judges value specific criteria differently.

From related literature and materials available from the Association, and incorporating suggestions from a review panel, a questionnaire containing one hundred eleven items which might have been used as criteria in the process was developed and sent to judges to be rated according to their value to them

when used for the evaluation of candidates for the OBTA award. Items in the questionnaire included those derived from:

- The comments by those who nominate or recommend
- The academic qualifications of the teacher
- The teaching and other experiences of the teacher
- The professional activities and accomplishments of the teacher
- The relationships of the teacher to his school and community
- The interrelationships which existed between the teacher, the subject, the students, and classroom organization.

Data developed by the study were analyzed to test the following null hypotheses:

1. There is no significant difference in the ways that judges rate individual criteria which are used for both the pre-selection and final evaluation phases of biology teacher evaluation.

2. There is no significant difference between the rating levels assigned by judges to the criteria used in evaluation of biology teachers.

3. There is no significant difference in the ways that criteria used in the evaluation of biology teachers are rated between members of different judge-groups.

The study attempted to find answers to the following questions:

1. Who are these judges of biology teachers? What variety of occupational and/or educational positions do they represent?

2. What criteria do they employ in the evaluation process? Are some criteria of more value to some judges than others?

3. Does the occupational status of a judge relate to the way he evaluates a biology teacher? If so, in what ways?

Because it was desired to determine whether the differences between ratings of individual items by separate judge-groups represented differences due to reasons other than chance, chi-square analyses were computed for:

1. The responses derived for each rating-level, within each separate judge-group;
2. The responses for each rating-level between each separate judge-group; and
3. The two responses given for each item when rated both for the pre-screening and final evaluation phases.

The degree of variance between expected and observed frequencies within each rating-level provided a measure of statistical significance. For purposes of the study, the .05 level was accepted as significant.

SIGNIFICANT CRITERIA

Out of the list of one hundred and eleven factors offered for rating, twenty-one were found to have been rated significantly high as usually to always important by the total group (Table 2).

Although judges were asked to rate each item twice, no significant differences were found between the ratings assigned to those which were used both for preliminary screening and for the final selection phases of evaluation. Apparently, if significantly important at all, an item was of similar value throughout the total evaluation process.

It was interesting to note that of the various groups of items, none of the items derived from the comments of those who nominate or recommend candidates, none of the items related to academic qualifications, none of the items related to teaching and other professional experiences, and none of the items related to the teacher's relationships to his school and community were rated significantly high by OBTA judges. Further, only one item was found to be significant in the category related to the candidate's professional activities and accomplishments, and that item related to the activities and accomplishments of his students.

Generally, the twenty-one items found to be rated significantly high in the list could be arranged into three major areas:

1. Items related to the teachers' intrinsic personal traits, including: interest and enthusiasm for biology, evidences of resourcefulness, adequacy of self-concept, evidences of ingenuity, emotional poise and self-confidence, evidences of creativity, and apparent interest in self-improvement;

2. Items related to teacher-student interrelationships, including: ability to encourage self-motivation in students, ability to inspire self-confidence in students, concerns for personal involvement by students in learning activities, favorable perceptions by students and parents, ability to facilitate worthwhile student interaction, understandings of individual student needs, provisions for differing student interests and needs, and efforts to encourage students to develop higher level skills, such as advancing hypotheses and theories.

3. Items related to concerns for skills and proficiencies as a science teacher, including: concerns for student understandings of essential concepts, concerns for students' understandings of essential science processes, skill in use of a variety of materials and methods, accomplishments of students, providing laboratory experiences characterized by thought-provoking problems, and ability to develop a classroom climate which facilitates learning.

Criteria found to be not significant included those related to the number and kinds of academic course experiences or degrees, grades received, location or size of school, years of teaching experience, teaching and managerial efficiency, participation in school, community or professional organizations, publications, honors or awards received, and the appearance of classroom and laboratory.

EVIDENCES OF EVALUATOR BIAS

As indicated, part of the study was to determine if evidences of bias on the part of judges who belonged to different occupational groups could be found. The data revealed that of the twenty-one items found to have been rated significantly high, eight were found to have been rated significantly different between different judge-groups (Tables 3 and 4). In every one of the eight instances, professors of science education rated the item higher than college professors of biology.

An analysis of each of these eight items follows:

1. Apparent Interest in Self-Improvement. Although the majority of each of the seven judge-groups rated this item high as usually or always important, only three-fourths of the Public School Science Supervisors group considered it so. This contrasted with over 97 percent of the Secondary School Teacher group and all of the Industrial Biologists. About 96 percent of Professors of Science Education and 88 percent of College Biologists rated it high. Over 6 percent of the latter group considered it rarely important.

2. Interest and Enthusiasm for Biology. Although more than half of all groups rated it as either usually or always important, all of the Public School Administrators, all of the Industrial Biologists, and all of the Professors of Science Education responding considered it usually or always important to them. Only about 83 percent of College Biologists rated it high.

3. Concerns for Student Understandings of Essential Concepts. Although all the Public School Administrators and over 95 percent of the Professors of Science Education responding to this item rated it usually or always important, only about 72 percent of the State Science Supervisors and 58 percent of the Public School Science Supervisors rated it high. In fact, over 16 percent of the Public School Science Supervisors and approximately 8 percent of the College Biologists responding to this item considered it to be rarely important. 85.4 percent of College Biologists rated it high.

4. Concerns for Student Understandings of Essential Science Processes. Although the majority considered this item to be usually or always important, differences existed between some groups. In this instance, all of the Professors of Science Education rated it high, while only 58.4 percent of the Public School Science Supervisors rated it thus. Almost 17 percent of the latter group considered this item to be rarely important. 78 percent of College Biologists rated this item high.

5. Ability to Inspire Self-Confidence in Students. Responses to this item were fairly diverse and ranged from 100 percent of responses as either usually-to-always important for the State Science Supervisor group, to only 50 percent of the Public School Administrators rating it high. Several respondents rated the item either rarely important or not important to them in the evaluation process. 80 percent of College Biologists and 82 percent of Professors of Science Education rated it high.

6. Activities and Accomplishments of Students. Analysis of data for this item revealed that although all of the Public School Administrators and Industrial Biologists rated it either usually or always important, this feeling was not shared by several of the other grouns. In fact, only about 47 percent of the Secondary School Teachers and a little less than 60 percent of the Public School Science Supervisors and College Biologists rated it high. Of significance were the responses which rated this item as rarely important or not important. These included Secondary School Teachers with 12.5 percent, Public School Science Supervisors with 16.7 percent, College Biologists with 10.7 percent, and Professors of Science Education with 8.3 percent. 79 percent of Professors of Science Education rated this item high.

7. Emotional Poise and Self-Confidence. Analysis of the data for this group revealed that of those responding to the item as an item of importance to them, all judges in the Industrial Biologist group rated it either usually or always important. This contrasted with Public School Science Supervisors and State Science Supervisors whose responses in these categories amounted to about 65 percent each. 17.7 percent of the Public School Science Supervisors and 10.9 percent of the College Biologists thought this trait to be rarely important to them. About 91 percent of Professors of Science Education and 78 percent of College Biologists rated this item high.

8. Adequacy of Self-Concept. Contrasts between the ratings assigned by various judge-groups were particularly noticeable for this item. Even though the majority of all groups rated this item high as usually or always important, 25 percent of the Public School Science Supervisors considered adequacy of the teachers' self-concept to be rarely important, along with more than 12 percent of the Public School Administrators. Only approximately 50 percent of the College Biologists rated the item high. Both Professors of Science Education and College Biologists rated this item lowest with 73.7 percent and 51.4 percent respectively.

SUMMARY AND CONCLUSIONS

Throughout the course of the study, the intent was to discover something about the evaluation of biology teachers and not to assess the worth of the Outstanding Biology Teacher Award program. The OBTA program was used because it offered an excellent opportunity to collect data about what judges of biology teachers value on an unusually comprehensive scale. The investigator does not wish his conclusions to be interpreted as judgements of the program, although he is impressed with it as a model for teacher evaluation by a professional group.

The study attempted: (1) to establish the criteria that judges in the Outstanding Biology Teacher Award program used when evaluating biology teachers; (2) to identify the various types of their occupations; (3) to establish whether

or not specific criteria were valued significantly different; and (4) to determine if occupational status of judges were significantly related to the way they rated specific criteria.

To facilitate brevity, conclusions are organized under each of the three null hypotheses established for the study:

Null Hypothesis 1:

> There is no significant difference in the ways that judges rate individual criteria which are used for both the pre-selection and final evaluation phases of biology teacher evaluation.

Analysis of the chi-square levels found for the combined ratings of all judges revealed that no significant differences existed between the ratings given to items when used for pre-selection and the ratings given to the same items when used for the final evaluation of candidates for the Outstanding Biology Teacher Award. Because the criteria were not rated significantly different, it appeared that judges made no important distinction between criteria which they used to pre-screen candidates and those they used to eliminate finalists. Thus, Null Hypothesis 1 was accepted.

Null Hypothesis 2:

> There is no significant difference between rating levels assigned to judges to the criteria used in evaluation of biology teachers.

Analysis of the chi-square levels derived for the ratings given to each of the one hundred eleven items revealed there were twenty-one items (Table 2), which possessed high rating levels that differed from what might have occurred by chance at the .05 level of significance or better.

Of the twenty-one items which judges rated high, seven related to factors associated with the teachers' intrinsic personal characteristics, eight related to factors of teacher-student interaction, and six related to skills and proficiencies as a science teacher. Factors which were rated lowest related to the teacher's academic background and preparation, his teaching experiences and responsibilities, and to his professional activities and accomplishments. Apparently, these latter factors were not as important to these judges. Because some significant differences were found, Null Hypothesis 2 was rejected.

Null Hypothesis 3:

There is no significant difference in the ways that criteria used in the evaluation of biology teachers are rated between members of the different judge-groups.

Analysis of chi-square derivations for ratings given to each of the one hundred eleven items of the questionnaire revealed that eight items were rated significantly different by different judge-groups. Thus, it was possible to say that the occupation status of a judge is related to the way he evaluates a biology teacher, and that the criteria he used were applied according to his expectations of the teacher's role. Therefore, Null Hypothesis 3 could also be rejected.

In conclusion, regarding evaluation of biology teachers, it is possible to say that specific criteria do exist which are significant to competent judges. And, if significant at all, these criteria are important generally, rather than being selectively applicable for making either preliminary or eventual decisions about the teacher's worth. Also, concerns for evaluator bias are real concerns, that various judges do value specific criteria differently, and that Professors of Science Education and College Biologists do differ somewhat in how they value specific criteria.

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Table 1

Occupational Groups Represented in the

1970 OBTA State Selection Committees

	Number on Committees	Replied
1. College Biologists	56	50
2. Secondary School Teachers	58	41
3. College Professors of Science Education	28	25
4. State Science Supervisors	21	18
5. Secondary School Administrators	17	16
6. Industrial Biologists	21	13
7. Local Science Supervisors	15	12
8. Other: Dentists	2	2
Director, Outdoor Education	1	1
Graduate Student, Education	1	1
TOTAL	220	179

Table 2

Significant Criteria Employed by Members of 1970 Selection Committees in Making Decisions About Candidates for the OBTA Award

Item	Significance
Interest and enthusiasm for biology	.001
Ability to encourage self-motivation in students	.001
Concerns for student understandings of essential concepts	.01
Ability to inspire self-confidence in students	.01
Concerns for student understandings of essential science processes	.01
Evidences of resourcefulness	.01
Adequacy of self-concept	.01
Concerns for personal involvement of student in learning activities	.01
Evidences of ingenuity	.01
Emotional poise and self-confidence	.05
Evidences of creativity	.05
Apparent interest in self-improvement	.05
Habits of dress, voice, mannerisms, speech	.05
Activities and accomplishments of students	.05
Provisions for differing student interest and abilities	.05
Laboratory experiences characterized by thought-provoking problems	.05
Efforts to encourage student development of hypotheses and theories	.05
Favorable perceptions by students and parents	.05
Facilitates worthwhile student interaction	.05
Ability to develop a classroom climate conducive to learning	.05
Perceptions of individual student needs	.05

Table 3

FACTORS FOUND TO BE RATED SIGNIFICANTLY DIFFERENT FOR EVALUATING BIOLOGY TEACHERS, LISTED BY INDIVIDUAL JUDGE-GROUPS

Item	Percent		
	Usually Important	Always Important	Total
SECONDARY-SCHOOL TEACHERS			
Apparent interest in self-improvement	36.6	61.0	97.6
Interest and enthusiasm for biology	29.3	68.3	97.6
Concerns for student understandings of essential science processes	34.1	58.5	92.6
Concerns for student understandings of essential concepts	29.3	61.0	90.3
Emotional poise and self-confidence	40.5	48.6	89.1
Ability to inspire self-confidence in students	35.9	51.3	87.2
Adequacy of self-concept	44.4	22.2	66.6
Activities and accomplishments of students	32.5	15.0	47.5
PUBLIC SCHOOL ADMINISTRATORS			
Concerns for student understandings of essential concepts	37.5	62.5	100.0
Interest and enthusiasm for biology	31.3	68.8	100.0
Activities and accomplishments of students	68.8	31.3	100.0
Concerns for student understandings of essential science processes	50.0	43.8	93.8
Apparent interest in self-improvement	37.5	56.3	93.8
Ability to inspire self-confidence in students	25.0	62.5	87.5
Emotional poise and self-confidence	53.3	33.3	86.6
Adequacy of self-concept	62.5	12.5	75.0

Table 3 (continued)

Item	Percent		
	Usually Important	Always Important	Total
PUBLIC SCHOOL SCIENCE SUPERVISORS			
Apparent interest in self-improvement	8.3	66.7	75.0
Interest and enthusiasm for biology	0.0	75.0	75.0
Ability to inspire self-confidence in students	9.1	63.6	72.7
Adequacy of self-concept	25.0	41.7	66.7
Emotional poise and self-confidence	8.3	58.3	66.6
Concerns for student understandings of essential concepts	16.7	41.7	58.4
Concerns for student understandings of essential science processes	16.7	41.7	58.4
Activities and accomplishments of students	25.0	33.3	58.3
STATE SCIENCE SUPERVISORS			
Ability to inspire self-confidence in students	27.8	72.2	100.0
Concerns for student understandings of essential science processes	33.3	61.1	94.4
Interest and enthusiasm for biology	41.2	52.9	94.1
Apparent interest in self-improvement	22.2	66.7	88.9
Concerns for student understandings of essential concepts	22.2	50.0	72.2
Adequacy of self-concept	44.4	27.8	72.2
Activities and accomplishments of students	33.3	33.3	66.6
Emotional poise and self-confidence	35.3	29.4	64.7

Table 3 (continued)

Item	Percent		
	Usually Important	Always Important	Total
INDUSTRIAL BIOLOGISTS			
Apparent interest in self-improvement	30.8	69.2	100.0
Emotional poise and self-confidence	41.7	58.3	100.0
Interest and enthusiasm for biology	16.7	83.3	100.0
Activities and accomplishments of students	38.5	61.5	100.0
Concerns for student understandings of essential science processes	0.0	92.3	92.3
Concerns for student understandings of essential concepts	0.0	92.3	92.3
Ability to inspire self-confidence in students	16.7	75.0	91.7
Adequacy of self-concept	58.3	16.7	75.0
COLLEGE BIOLOGISTS			
Apparent interest in self-improvement	24.5	63.3	87.8
Concerns for student understandings of essential concepts	27.1	58.3	85.4
Interest and enthusiasm for biology	22.4	61.2	83.6
Ability to inspire self-confidence in students	34.8	45.7	80.5
Emotional poise and self-confidence	45.7	32.6	78.3
Concerns for student understandings of essential science processes	23.9	54.3	78.2
Activities and accomplishments of students	34.0	25.5	59.5
Adequacy of self-concept	37.1	14.3	51.4

Table 3 (continued)

Item	Percent		
	Usually Important	Always Important	Total
COLLEGE PROFESSORS OF SCIENCE EDUCATION			
Interest and enthusiasm for biology	12.5	87.5	100.0
Concerns for student understandings of essential science processes	26.1	73.9	100.0
Apparent interest in self-improvement	16.7	79.2	95.9
Concerns for student understandings of essential concepts	21.7	73.9	95.6
Emotional poise and self-confidence	36.4	54.5	90.9
Ability to inspire self-confidence in students	13.0	69.6	82.6
Activities and accomplishments of students	29:2	50.0	79.2
Adequacy of self-concept	31.6	42.1	73.7

TABLE 4

FACTORS FOUND TO DIFFER SIGNIFICANTLY
BETWEEN VARIOUS JUDGE-GROUPS

Judge-Group		Rating Level 1	2	3	4	5	Percent Rating the Items High
Apparent Interest in Self-Improvement							
Professors of science education	a	0	0	1	4	19	
	b	0.0	0.0	4.2	16.7	79.2	95.9
College biologists		3	0	3	12	31	
		6.1	0.0	6.1	24.5	63.3	87.8
Emotional Poise and Self-Confidence							
Professors of science education		1	1	0	8	12	
		4.5	4.5	0.0	36.4	54.5	90.9
College biologists		1	4	5	21	15	
		2.2	8.7	10.9	45.7	32.6	78.3
Concerns for Student Understandings of Essential Concepts							
Professors of science education		0	0	1	5	17	
		0.0	0.0	4.3	21.7	73.9	95.6
College biologists		2	2	3	13	28	
		4.2	4.2	6.3	27.1	58.3	85.4
Interest and Enthusiasm for Biology							
Professors of science education		0	0	0	3	21	
		0.0	0.0	0.0	12.5	87.5	100.0
College biologists		2	1	5	11	30	
		4.1	2.0	10.2	22.4	61.2	83.6

TABLE 4 (continued)

Judge-Group		Rating Level 1	2	3	4	5	Percent Rating the Items High
Activities and Accomplishments of Students							
Professors of science education	a	0	2	3	7	12	
	b	0.0	8.3	12.5	29.2	50.0	79.2
College biologists		2	3	14	16	12	
		4.3	6.4	29.8	34.0	25.5	59.5
Ability to Inspire Self-Confidence in Students							
Professors of science education		0	2	2	3	16	
		0.0	8.7	8.7	13.0	69.6	82.6
College biologists		0	3	6	16	21	
		0.0	5.5	13.0	34.8	45.7	80.5
Adequacy of Self-Concept							
Professors of science education		0	1	4	6	8	
		0.0	5.3	21.1	31.6	42.1	73.7
College biologists		1	1	15	13	5	
		2.9	2.9	42.9	37.1	14.3	51.4
Concerns for Student Understandings of Essential Science Processes							
Professors of science education		0	0	0	6	17	
		0.0	0.0	0.0	26.1	73.9	100.0
College biologists		2	2	6	11	25	
		4.3	4.3	13.0	23.9	54.3	78.2

[a]Number of responses

[b]Percent of responses

Note: 1 = Not Important; 2 = Rarely Important; 3 = Sometimes Important; 4 = Usually Important; 5 = Always Important.